

## Minor Successions from the Cladonia Mat in Sandy Upland Soil in Northern Michigan

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During the course of study of the effect of Cladonia and moss mats upon the germination and establishment of seedlings in the sandy pineland aspen areas at the University of Michigan Biological Station in Cheboygan County, Michigan, during 1927, certain successions were noticed which are here dealt with separately.

The Cladonia areas undergo distinct succession stages and represent minor associations in themselves. The succession is not always the same, but generally follows one of two courses. (a) If the area be open and unshaded by surrounding trees, the Cladonia will survive for a long period of time. Invasion by other plants is limited to those reproducing by rootstocks, or by a few seedlings which have become established in the cracks between the mounds or cushions of Cladonia. In the area studied these invading plants from rootstocks were limited to *Pteris aquilina*, *Diervilla lonicera*, and *Vaccinium angustifolium*. The seedlings found were chiefly of *Melampyrum lineare*, and occasional seedlings of *Aster laevis* and *Aster macrophyllus*. These plants, chiefly the Pteris, slowly drive out the Cladonia by producing shade, and other less tolerant seedlings become established under them. Late stages in this succession show such plants as *Oryzopsis asperifolia*, *Solidago hispida*, *Aster laevis*, *Carex umbellata*, and *Gaultheria procumbens* well established along with the Pteris and Vaccinium. Thus the Cladonia is gradually broken up and disintegrated, allowing any available seeds to germinate and become established where formerly they would not have had a chance.

(b) The other type of succession is found in areas where the soil is richer and a little more shaded. In the pure beds of *Cladonia rangiferina* come up innumerable moss plants, mostly of *Polytrichum juniperinum* and *Ceratodon purpureus*. During a wet spell, the spores, lighting on the damp spongy Cladonia find ideal conditions for germination. The protonema grows all through the Cladonia, contact with the soil being unnecessary for their development. From this come up innumerable leafy moss plants which soon begin to crowd out the Cladonia.

Periods of drought have little ill effect on the establishment of the mosses, since they are extremely xerophytic forms, used to drying out without injury.

Late stages in this succession show seedlings well established in the moss and by their shade killing off the mosses. The species represented by the seedlings are in general the same as were found in the other type of succession.

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